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Review Article

A literature review on the imaging methods for breast cancer

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Abstract: Breast cancer will be easier and more effective to treat if detected early. Breast cancer is assessed and detected using imaging as a primary approach. The capacity to diagnose breast cancers is continually improving thanks to developments in imaging technologies. However, some of these enhancements have been linked to delays in the initiation of treatment procedures of breast cancer. Overall, cancer management relies heavily on imaging procedures such as screening and symptomatic disease management. Mammography, which is considered the gold standard, and breast ultrasonography are employed as routine imaging modalities. Previous research has shown that, despite recent developments, no single imaging modality can detect and characterizing majority of breast lesions. Various imaging methods and their uses in diagnosing and caring the breast cancer are discussed in this study.

Keywords: Neoplasm, breast, ultrasound, imaging technology

Introduction

Cancer is one of the non-communicable diseases, which causes high mortality rates worldwide, accounting for 12% of all fatalities, with around 12 million new cases diagnosed each year [1, 2]. This cancer is responsible for almost 24.2% of new cancers in females [3]. Breast cancer would account for 11.7 percent of all cancer cases in 2025, with an estimated 2.3 million new cases in women, surpassing pulmonary cancer as the main cause of global cancer incidence [4, 5]. According to a survey of the literature, there were approximately two million new cases of breast cancer and 626,679 fatalities reported in 2018 [6]. This cancer could also harm women with younger ages [7]. In comparison to other races, Iranian women have a larger breast density [8, 9]. According to surveys, 90 percent of females with breast cancer survive; however, for women with advanced disease, the survival rate reduces to 60 percent [10]. Despite the adoption of harsh medicines in recent years, fatality rates have remained high, prompting greater research into new cancer treatment options [11, 12]. Imaging is used in all stages of neoplasm treatment [13]. Imaging technologies, which are a key part of cancer clinical procedures, are the first step in diagnosing the disease [14]. Medical imaging has a number of advantages, including real-time monitoring without tissue loss, long-term usage, and a less invasive process [11]. In a literature review, Leonard Fass (2008) and Safarpour Lima and colleagues (2019) found that cancer care is dependent on imaging through screening [11, 14]. Breast cancer can be detected early using imaging tools [6]. The sensitivity and specificity of various techniques, however, vary [15, 16]. Integrated imaging techniques, according to evaluations, can provide additional data about the disease managemen

[11]. Complementary imaging includes screening mammography, ultrasonography, and a mixture of these procedures [14]. Additional screening modalities, such as ultrasonography, are recommended for women with thick breast tissue due to an increase in false-negative mammography [17]. Combining the screening ultrasound with mammography, according to Berg and colleagues (2008), will lead to a significant decrease in diagnosis of cases, but will also vastly enhance the number of false positives [18].

Diagnostics will be enhanced by combining many imaging modalities [19]. This article discusses new scientific methods for analyzing, diagnosing, and evaluating benign and aggressive breast cancer.

Imaging techniques

Because of changes in physical qualities, images produced by imaging instruments show differences in contrast. Digital imaging technologies are gaining significant attention of X-ray-based techniques in cancer imaging. A magnetic resonance system is used to detect cancer, stage it, assess therapy response and guide biopsy procedures [14].

Digital imaging technology

Mammography is a common screening tool [20]. Mammography screening for malignancy is commonly used to detect the disease [7]. It is reported in multiple studies to help decrease cancer death rates [7, 21]. Although mammography can be used to imaging young, compact breasts, it is insufficiently sensitive to detect lesions since the surrounding fibro glandular tissue obscures lesions' appearance [11]. Mammography on film is the "gold standard" of detecting breast neoplasm [22]. Though it can also be used for early identification and follow-up of tumors [7], does have some inherent limitations, such as screen-film mammography's limitations, poor contrast features [23]. Full-field digital mammography (FFDM) is a useful imaging method for breast screening that offers a number of benefits over traditional film-based treatments. Reduced dose, telemedicine, softcopy review, tomosynthesis and digital archiving are just a few of the advantages [14]. It's worth noting that traditional film-screen mammography has cost and availability benefits [24].

In a research named "Screen-Film Mammography versus Full-Field Digital Mammography with Soft-Copy Reading", Skaane and Skjennald (2004) found that mammography had a greater cancer detection results than screen-film mammography in the 50-69 age category. The detection rates for the two systems were nearly identical in the 45-49 age group [25]. In a study, Obenauer and colleagues found that digital mammography has high image quality compared to screen film [26]. The overlaying and concealing of cancers by normal tissues such as glandular tissue is one of the potential limitations of 2D mammography [11]. Using X-ray equipment could help to minimize breast tightness [14]. Iodinated agents are used in contrast-enhanced mammography as an exploratory approach [27]. This experimental technology is based on the idea that rapid tumor growth necessitates increased blood supply via angiogenesis [13]. Contrast must be supplied if the compression tool is not active. The contrast agent will accumulate in angiogenesis sites [27]. Tomosynthesis may be useful for diagnosing primary and secondary lesions as well as monitoring therapy [11, 28].

Ultrasonography

Breast cancer is diagnosed via ultrasonography, which is a standard imaging procedure. In recent years, it has advanced to the point that it can now be used for breast imaging [7]. Ultrasound is a technology used as a follow-up examination to clarify equivocal findings [29]. In primarily fatty breasts and dense breasts, ultrasonography can be used to assess the orientation and morphology [30]. A panoramic high-resolution image of the breast is obtained using extended field of view imaging [31, 32]. Elastic sonography is a typical approach for detecting breast lesions using ultrasonic detection [33]. Ultrasound with contrast is used to detect and monitor the progress of local treatment [34]. Intravenously injected gas microbubbles are used in this approach [35]. The volume of a lesion can be calculated using 3D ultrasonography [36].

Even though some researchers believed that using ultrasonography to detect cases missed by mammography would increase the number

Table 1. Comparison of sensitivity and specificity of imaging technologies in breast cancer[1]

First author (year)	M		US		MRI		Ref.
	SE (%)	SP (%)	SE (%)	SP (%)	SE (%)	SP (%)	
Kuhl (2000)	33.0	30.0	33.0	12.0	100.0	64.0	[47]
Warner (2001)	33.0	-	60.0	-	100.0	-	[48]
Berg (2004)	67.8	75.0	83.0	34.0	94.4	26.0	[49]
Kuhl (2005)	32.6	96.8	39.5	90.5	90.7	97.2	[46]
Warner (2008)	32.0	94.7	-	-	75.0	96.1	[50]
Sardanelli (2011)	50.0	99.0	52.0	98.4	91.0	96.7	[51]
Lehman (2012)	61	94	96	89	-	-	[52]
Tan (2014)	49	89	82	84	-	-	[53]
Song (2015)	66.7	89.5	83.3	71.1	100.0	61.8	[54]
Berg (2016)	53	90	52	86	-	-	[55]
Omidiji (2017)	86	56	89	22	-	-	[56]

[1]M: Mammography; US: Ultrasonography; MRI: Magnetic resonance imaging; SE: Sensitivity; SP: Specificity.

of false-positive masses [37]. Berg and colleagues (2008) found that employing ultrasonography in conjunction to mammography improved diagnosis accuracy [18]. When comparing mammography with ultrasound findings, one study discovered that mammography is recommended for breast cancer [38]. In a 2008 report, it was discovered that screening ultrasound can detect tiny, node-negative breast tumors [18]. Finally, the scientists found that clinical diagnosis, ultrasonography, and mammography could predict breast neoplasm [39]. In another survey that was conducted by Devolli-Disha and colleagues, they evaluated 546 women with breast complaints and discovered that ultrasonography had a statistically significant higher than mammography in patients with breast complaints [40].

Magnetic resonance imaging (MRI)

Breast MRI is used in conjunction with mammography as a support tool [11]. Ross and colleagues (1982) employed MRI to examine breast neoplasm [41]. Breast MR is gradually gaining acceptance as a supplementary tool. Although MRI has a greater sensitivity than mammography, it is not frequently utilized as a breast cancer surveillance test due to high false positives and high costs [42]. Breast MRI is a beneficial method for screening in women who have dense breast tissue [11]. The American Cancer Society has validated that MRI can detect contralateral breast neoplasm extension [11]. Because of these issues, MRI looks to be preferred to mammography [43]. This discrepancy suggests that magnetic resonance imaging can be helpful in deciding whether to have a breast-conserving mastectomy or surgery. Recent advances in MRI technologies has enabled more accurate cancer detection and anatomical delineation [44, 45].

Some research suggest using a combination of approaches to detect breast cancer early [15]. According to a study, mammography alone, as well as mammography and ultrasonography, is not sufficient for early diagnosis [46]. **Table 1** presents and compares the sensitivity and specificity values of imaging methods.

Conclusion

Early diagnosis of breast cancer is likely the most important factor in cancer fatality reduction and is critical for successful treatment. Breast screening aims to discover cancer early, when therapy is more likely. Imaging techniques are currently used to diagnose breast cancer. However, due to existing imaging technologies' low sensitivity and specificity, demand for new imaging techniques has grown in the diagnosis of this disease.

Disclosure of conflict of interest

None.

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